

# **CHARACTERIZATION, MONITORING, AND SENSOR TECHNOLOGY CROSSCUTTING PROGRAM OVERVIEW**

## **PURPOSE**

The purpose of the Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP) is to deliver appropriate characterization, monitoring, and sensor technology (CMST) to the Office of Waste Management (EM-30), the Office of Environmental Restoration (EM-40), and the Office of Facility Transition and Management (EM-60).

In addition to being appropriate for EM-30/40/60s needs, the technology development must be cost effective. Furthermore, the required technologies must be delivered and implemented when needed. Accordingly, and to ensure that available DOE and other national resources are focused on the most pressing needs, management of the technology development is concentrated on the following Focus Areas:

- I. Mixed Waste Characterization, Treatment, and Disposal
- II. High-Level Waste Tank Remediation
- III. Contaminant Plume Containment and Remediation
- IV. Landfill Stabilization
- V. Decontamination and Decommissioning,

## **TECHNOLOGY NEEDS**

The EM mission cannot proceed intelligently, safely, or economically unless the problems it addresses and the processes it employs are adequately characterized or monitored. A common problem is that the costs of characterization and monitoring technologies are unacceptably high. Another is that critical characterization, monitoring, and sensor technologies needed to address several of the most important EM problems are not available, are not yet accepted by regulators, or have not been proven under EM mission conditions. Examples of needed characterization, monitoring, and sensor technologies are listed below, by Focus Area.

Plumes Focus Area: Instrumentation and methods for determination of the location, nature, level, and 3-dimensional extent of Dense Non-Aqueous Phase Liquids (DNAPLs) in the subsurface; sensors and instrumentation for subsurface deployment by cone penetrometer or other minimally intrusive methods for determination of metal and radioactive contaminants.

**Tanks Focus Area:** In situ sensor systems for determination of physical properties, gross matrix characteristics, and chemical constituents of tank waste; sensor deployment systems, including cone penetrometer sensor systems to deploy into tank waste and novel remote sensing deployment systems such as fiber-optic laser systems; on-line process monitors and controls for retrieval, transfer, and treatment operations.

**Mixed Waste Focus Area:** Safe, fast, and economical instrumentation and methods for characterization and monitoring of mixed waste in containers and mixed waste treatment processes, effluents, and final waste forms—for assurance of worker, public, process, and facility safety, and to assure the quality and public acceptance of treatment processes and final waste forms.

**Landfill Stabilization Focus Area:** Instrumentation and methods for establishing and monitoring the integrity of subsurface barriers; non-intrusive geophysical methods to characterize and locate buried waste, buried structures, waste zones, and geologic structures.

**Decontamination and Decommissioning:** Sensors and instrumentation for non-destructive assay of Resource Conservation and Recovery Act (RCRA) metals and radionuclides in process equipment, ducts, pipes, and soils; technologies for real-time monitoring of the progress and quality of decontamination.

All the Focus Areas have characterization and monitoring development needs; therefore technology that is developed for one Focus Area can often be adapted to solve problems in another. The CMST-CP identifies technology gaps, integrates technology development, and leverages resources to achieve synergy in development and to provide cost-effective solutions. The resources include those of other federal agencies, private companies, and universities as well as those within the DOE. The CMST-CP promotes collaboration with other federal agencies through interagency agreements (IAGs). Private sector R&D involvement is promoted through Cooperative Research and Development Agreements (CRADAs), Program Research and Development Announcement (PRDA), Research Opportunity Announcements (ROAs), the Small Business Innovation Research (SBIR) program, and the Technology Reinvestment Project (TRP). The CMST-CP provides necessary coordination to achieve timely and cost-effective development and implementation of needed characterization, monitoring, and sensor technologies.

## **WINDOWS OF OPPORTUNITY FOR THE CMST-CP**

Characterization, monitoring, and sensor technology is needed throughout the EM process. The functional needs include:

- Initial location and characterization of wastes and waste sites before treatment

- Monitoring of waste retrieval and remediation processes
- Characterization and monitoring of waste treatment processes, products, and effluents
- Site closure and long-term compliance monitoring

The priorities and schedules for CMST development and implementation must conform to the directions and needs specified by the Focus Areas.

## ACCOMPLISHMENTS

- The CMST-CP currently supports technology development projects in all five Focus Areas. The CMST needs statements in the solicitations for PRDA, ROA, and SBIR grant applications were developed by CMST-CP team members who worked closely with representatives of the Focus Area Management Teams and other customer representatives to discern and describe the Focus Area needs. The needs statements were subsequently reviewed and validated by the Site Technology Coordination Groups (STCGs) and DOE authorities.
- Representatives from the five Focus Areas were invited to participate in the CMST-CP Program Meeting. Activities included their presentations on CMST needs, principal investigator (PI) presentations, and a panel session on plans for technology transfer and commercialization.
- At the Program Meeting, the CMST-CP conducted expert technical and customer reviews of 27 FY95 CMST-CP projects. Each was reviewed by three technical experts and two to four Focus Area representatives. (The review team consisted of 21 technical reviewers and 10 Focus Area representatives.) About 110 people attended. The evaluation information was transmitted to the PIs through the Technical Program Officers (TPOs) and Technical Program Managers (TPMs).
- The Tanks Focus Area (TFA) and the CMST-CP jointly evaluated 54 proposals received in response to the August 1995 joint Call for Proposals for CMST development. The CMST-CP provided technical evaluators; the TFA provided evaluators representing users' needs at the Savannah River and Hanford Sites. Three representatives of the Mixed Waste Focus Area (MWFA) also served as user needs evaluators. The evaluation produced a consensus recommendation of five proposals for FY96 funding.
- The CMST-CP conducted an expert technical and customer review of CMST-CP funded FY95 and proposed FY96 characterization/monitoring work at the Diagnostic Instrumentation and Analysis Laboratory (DIAL) at Mississippi State University (MSU), Starkville, Mississippi. The projects and proposals were evaluated September 13 and 14, 1995, at MSU by technical peers and Focus Area customer representatives.

- CMST-CP staff provided technical input for review of 26 new CMST tasks proposed for funding by the Landfill Stabilization Focus Area (LSFA) and MWFA. The input was provided to the Landfill and Mixed Waste Implementation Teams.
- CMST-CP staff participated in the expert technical evaluation of 40 CMST proposals received in response to the Morgantown Energy Technology Center (METC) ROA solicitation entitled "Applied Research and Development of Technologies for Environmental Restoration and Waste Management II."
- CMST-CP staff participated in the expert technical evaluation of 52 CMST proposals received in response to the METC PRDA solicitation entitled "Characterization, Monitoring, and Sensor Technology (CMST) Development."
- CMST-CP staff coordinated the review of 20 SBIR grant applications received in response to the FY95 solicitation topic entitled, "Characterization, Monitoring, and Sensor Technologies for Radioactive and Hazardous Waste." In addition, they either provided or arranged for expert technical reviews of numerous Phase I ROA and SBIR reports and Phase II extension proposals.
- CMST-CP staff reviewed abstracts of and submitted scoring sheets for 59 papers submitted for presentation at the Technology Information Exchange (TIE) workshop, April 16 to 18, 1995 in Santa Fe, New Mexico.
- CMST-CP staff served on the Rapid Commercialization Initiative (RCI) peer review panel for the monitoring and assessment technology category and reviewed 10 proposals submitted in response to the RCI Announcement issued August 16.
- The CMST-CP sponsored Expedited Site Characterization (ESC) at the DOE Pantex Plant Zone 12 Groundwater Investigation and Savannah River D-Area Oil Seepage Basin sites.

#### **CMST-CP PERSONNEL PARTICIPATED IN**

1. Development of the "Mixed Waste Characterization Reference Document"
2. A workshop on Non-Destructive Assay/Non-Destructive Evaluation (NDA/NDE) technology development projects funded by EM-50
3. Development of the "Environmental Science and Technology Strategic Plan, 1996-2005"
4. Site visits with Focus Area team members to collect information about site technology needs and schedule requirements

The CMST-CP has distributed the CMST Progress Report, a monthly compilation of the technical progress reports from all CMST-CP projects since November 1993. With the cooperation and assistance of METC personnel, the progress report has also included reports from CMST projects funded through PRDA and ROA activities since October 1994. This is part of a continuing effort to disseminate information about CMST development activities to potential customers.

## **TECHNOLOGY COLLABORATION/TRANSFER**

The CMST-CP technology transfer roadmap consists of six main sections: needs assessment, identification of technologies for transfer, a managing-technology-for-development (MTD) process, a technology de-risking process, a technology verification (and/or certification) process, and a “hands-on” technical assistance process. Through the use of this roadmap process, many barriers that impede acceptance of new technologies have been identified and mitigated.

CMST-CP staff organized a workshop and forum on Chemical Sensors for Environmental Applications. The preliminary results of a market study on existing technologies and users’ needs were presented both at the two-day workshop and at the afternoon forum. The market study was commissioned to Unimar, a marketing research firm that was one of 14 respondents to a related request for proposals. The workshop was held immediately prior to the Pittsburgh Conference in Chicago. More than 80 users, developers, and manufacturers of chemical sensors and field deployable analytical instrumentation participated, dealing with issues concerning developing, adapting, and commercializing analytical instrumentation technologies for environmental analysis. The objectives of the workshop and forum were to:

- Identify existing sensor technologies appropriate for EM field deployable environmental analysis and sensing
- Determine the present and potential market demand for commercial field deployable environmental analysis instrumentation
- Publicize, as widely as possible, market information relevant to commercial field deployable environmental analysis instrumentation
- Encourage the redirection of existing technologies or the development of innovative technologies as commercial products for field deployable environmental analysis

The CMST-CP provided support for beta-site testing of the Sandia Robust Hydrogen Sensor at Hanford for monitoring high-level tank headspace gas. The sensor achieved faster response and higher sensitivity than the current practice; however, it failed to meet the ruggedness requirement. Sandia





National Laboratory (SNL) is working with a commercialization partner to improve the product packaging and design.

The CMST-CP, jointly with the EPA Consortium for Site Characterization Technologies (CSCT), sponsored the "RCRA and Other Heavy Metals in Soils Demonstration." This activity was organized by MSE, Inc., the prime contractor for the DOE Western Environmental Technology Office; Sandia National Laboratory, a technology verification entity under contract to the CSCT; and the Ames CMST-CP and Technology Transfer projects office. Four technology developers participated in the field demonstration activities during the week of September 25, 1995, in Butte, Montana. Split samples were archived and sent to two EPA laboratories for confirmatory analyses. The final evaluation report, scheduled to be issued by the EPA in March-April 1996, will not only detail the performance (and cost of performance) of demonstrated technologies against individual developer or vendor claims, but also comparatively evaluate these field performance data with results gained from using baseline, laboratory EPA methods. The performance of the four technologies under differing matrices and test conditions will be documented in accordance with a well-defined quality assurance/quality control (QA/QC) data protocol.

The CMST-CP is also pursuing the opportunity to participate in the "Rapid Commercialization Initiative," a coordinated effort between the Department of Commerce, Department of Defense, EPA, and DOE. In addition, verification activities dealing with continuous emissions monitoring technologies for the detection of heavy metals and volatile organic compounds (VOCs) are being planned.

The CMST-CP provided exhibits for the following meetings:

- Interagency exhibit sponsored by the U.S. Senate Environment and Public Works committee
- International Symposium and Trade Fair on the Cleanup of Manufactured Gas Plants, Prague

Recent Presentations and Publications include the following:

E. Lightner and C. Purdy, "Cone Penetrometer Development and Testing for Environmental Applications," *Proceedings of the CPT '95 Symposium*, Sweden, (1995).

Glenn Bastiaans, "The Department of Energy Office of Environmental Management's Role in the Development of Chemical Sensors for the Environment," presented at the 188th Meeting of the Electrochemical Society, (October, 1995).

P. Wang, T. A. Zachry, M. S. Anderson, and J. B. Paladino, "Roadmap Process for Commercialization and Use of Emerging Characterization and Monitoring Technologies," to be published in the *Proceedings of Waste Management '96*.

W. Haas and N. B. French, "A Survey of Continuous Emissions Monitoring Technologies for Volatile Organic Compounds, HCl, and Ammonia," Presented at the 1996 International Conference on Incineration and Thermal Treatment Technologies, (May, 1996).

P. Wang, C. Purdy, and E. Lightner, "Emerging Technologies for Environmental Characterization and Monitoring," *Proceedings of the International Topical Meeting on Nuclear and Hazardous Waste Management, Spectrum '96*, (August, 1996).



## **FUTURE DIRECTIONS**

Knowledge and understanding of the CMST needs of the Focus Areas are critical for success. Hence, the CMST-CP will continue to concentrate on establishing excellent communication with the STCGs and the Focus Area Management and Implementation Teams. Future activities will be influenced more by the specific needs of site technology customers and stakeholders, and less by the interests and capabilities of technology developers.

The chief technical responsibility of the CMST-CP will continue to be development and implementation of new and emerging CMST applicable to EM needs. Near-term thrusts will include:

- Promotion of ESC, including multidisciplinary ESC teams in the private sector
- Field usable sensors and systems integrated with non-invasive tools for real-time determination of chemical/physical properties in the subsurface
- In situ sensors to determine spatial variability of chemical/physical properties of tank waste content
- Sensor technologies to support HLW retrieval and immobilization operations; continuous monitoring technologies for offgas and effluent streams to ensure optimized treatment process control
- Front-end characterization of containerized wastes for treatment; on-line sensors for real-time monitoring of chemical/radioactive contaminants during decontamination operations
- Development of more effective teaming with the DoD, EPA, and other government agencies with interests in CMST

In accordance with the best available information from the Focus Area Management and Implementation Teams and the STCGs, the CMST-CP will attempt to deliver required new technologies and technology improvements, when needed, through coordinated and focused development efforts in the DOE as well as in other federal agencies, the private sector, and universities. The goal is rapid development and effective application of CMST needed for the EM mission.

The remainder of this document contains brief descriptions of CMST-CP projects funded in FY95. Please see the *METC Technology Summary* and the *Innovative Investment Area (IIA) Technology Summary* for information on other EM-50 projects related to characterization, monitoring, and sensor technologies. Detailed information on any project can be obtained by contacting the PI. Contact information is provided in each project summary.



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